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GLIMPSES AT THE PAST AND FUTURE OF THE CHICAGO WATER SUPPLY¹

By JOHN ERICSON²

This is an informal talk made at the request of the new city engineer of Chicago, Alexander Murdock, and is based on the information gathered and opinions formed during a connection of about 37 years with the water works of the city. So much has been written and said about the subject that it is difficult to tell anything new, but an attempt will be made to show how the experience of the past throws light on the problems of the future.

When the author first entered the city's service in 1884 the area of the city was 37 square miles and its population was 601,000. There were two pumping stations, the Chicago Avenue Station and the so-called West Side Station on Ashland avenue near 22nd Street. Each station had old-style vertical beam engines, the oldest one, "Old Sally" at Chicago Avenue, having been installed in 1853, and the newest ones, the pumps at the West Side Station, in 1876. Some additional beam engines were placed in this station in 1884. The nominal capacity of the Chicago Avenue Station was 56,000,000 gallons, and of the West Station 30,000,000 gallons per day. There were two tunnels, 5 feet and 7 feet in diameter, supplying these stations from a crib located at that time two miles from shore. The distribution system consisted of 520 miles of cast iron mains, interspersed with some remnants of old bored logs.

Today the population of the City is 2,800,000 and its area about 200 square miles. There are ten large stations with a combined nominal capacity of 1,170,000,000 gallons per day and more additions are under way. There are about 64 miles of water tunnels supplying these stations from six intake cribs, and the water is distributed through 2940 miles of mains. From the old beam engines the pumping machinery has developed into high-grade triple-expansion engines

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and turbine and motor-driven centrifugal pumps. There are now 52 pumping engines in the system.

The development in the design of intake cribs has also shown a steady progress, from the early wooden structures with their great buoyancy and expensive protecting breakwaters, to structures built of steel, concrete and stone throughout, the new Wilson Avenue crib being an example.

When the first 5-foot lake tunnel, proposed by Mr. Chesbrough in the early 60's, was up for consideration, many engineers and builders declared the project impractical. The tunnel was built, however, and was at that time considered a great feat of engineering. Since that time there has been a gradual increase in the size of the intake tunnels. When the Four Mile Tunnel off 12th street was designed in later 80's, the size was increased to 8 feet, and a contract awarded the for its construction. After the tunnel had been constructed lakeward for some distance, the contractor apparently got "cold feet" and succeeded in convincing the city authorities that to continue the construction as an 8-foot tunnel under the lake was impracticable, and thus obtained permission to substitute two parallel 6-foot tunnels in place of the 8-foot tunnel. Incidentally, this also increased the cost of this improvement by over \$100,000.

When, in 1895, the author was requested to design a lake tunnel to supply the proposed Springfield Avenue and Central Park Avenue pumping stations on the West Side, it was, after due investigation, deemed practicable and advisable to make this tunnel 10 feet in diameter. Even then there were determined efforts made to change the design. After the contract had been let and the tunnel pushed lakeward about a thousand feet, the contractor and others left no stone unturned to have the plans changed so as to permit the construction of two parallel 8-foot tunnels in place of the 10-foot tunnel. Those who were familiar with the situation at that time will remember the stubborn fight which had to be made to prevent this change. The tunnel was afterwards constructed as a 10-foot tunnel without any serious difficulties whatever and in a perfectly straight line from the shaft at the foot of Oak street to the Carter H. Harrison Crib.

As still larger tunnels were afterwards deemed desirable, a further and special investigation was made regarding this subject, and in projecting the 14-foot lake tunnel in 1907 from the foot of 73rd street to the Dunne Crib it was decided to go deep enough to bring the bore of the tunnel into solid rock. The Wilson Avenue tunnel,

12 and 13 feet in diameter, completed in 1918 by day labor, is also constructed through solid rock; likewise, the new Western Avenue tunnel system, now under construction.

Where large tunnels are required and suitable rock is exceptionally deep, the problem will again have to be given special consideration. Sometimes, years after the tunnels have been built, those responsible for the work have been criticized because the tunnels were not made larger. The unforeseen growth of the city, both by annexations and actual increase in population, has greatly increased the demand for water above what could be reasonably anticipated when the earlier tunnels were planned, and the limitations as regards the art of lake tunnel construction when those tunnels were built should answer such criticisms. There are other reasons that will be touched upon later.

One of the drawbacks in the development of the water supply system of Chicago has been the constantly increasing abnormal demands upon the system, the per capita pumpage having been at times among the highest in the world. This average per capita pumpage has been steadily increasing year by year until in 1920 it amounted to 265 gallons, without satisfying all demands.

Twenty years ago in making an investigation as to what becomes of the water pumped for city uses, the author came to the conclusion that a great percentage of the water is lost through unwarranted waste and leakage. A campaign for the reduction of this great waste was then inaugurated, and has been kept up intermittently ever since, with more or less discouraging results. The optimistic view taken of the prospect of remedying this situation in the earlier part of this campaign may have had its effect in not pushing new additions to the system as hard as if the great opposition to water meters and other restrictive measures had been anticipated.

The campaign, however, led to systematic water surveys and the organization in 1907 of a permanent engineering corps in the distribution or so-called Water Pipe Extension Division of the Bureau of Engineering. The valuable work done and being done by this small corps of engineers is known and appreciated by but few. Through their efforts it is now possible to pierce through the soil with our mental eyes, discover the weak links in the system, and trace the thousands of streams of water that disappear without doing any useful service. In planning for the future, from time to time, this work has been of inestimable value, and since the last study for future require-

ments was inaugurated in 1916, the work was developed to a point so that there is now a complete record showing the use and abuse of the water supply, and an intelligent estimate of future requirements of water in every square mile of the city can be made.

In the early days, before the construction of the Chicago Drainage Canal, the quality of the water supply was very bad. On a survey made for the Chicago Drainage and Water Supply Commission in 1887, after a rather protracted rainfall, the author personally traced the field of highly polluted Chicago River water for over two miles out into the lake, where it extended beyond and surrounded the only intake crib at that time. The death rate in those days from typhoid fever amounted to as high as 173 per 100,000 inhabitants. The opening of the Drainage Canal greatly relieved this situation, but, as the city continued to grow by leaps and bounds, there were and still are periods when the typhoid death rate shows an increase and when the people are warned to boil their drinking water.

In 1912 the first experimental hypochlorite of lime installation was made at one of the intake cribs, but it was operated under more or less severe difficulties. A second installation more carefully constructed was later installed at another crib, but still with unsatisfactory results. A year or two later, sufficient experiments had been made with liquid chlorine to warrant such installations at some of the pumping stations. These installations have gradually been extended and improved until the deaths from typhoid during the past few years have dwindled to around 1 per 100,000. The question now is: Will this solve the sanitary question as regards our water supply for the future? H. O. Garman, chief engineer of the Indiana Public Service Commission, recently read a paper before the Indiana Sanitary and Water Supply Association, in which he said:

Few committees appreciate that it is but one step from home to the cemetery and that our place in a home or in a cemetery is absolutely in the hands of some obscure, unknown, underpaid, and too often unappreciated employee of the purification department of our water utilities. The management and operation of a water utility is almost a sacred occupation.

This about expresses the author's view when some eight or ten years ago, he recommended that an expert sanitary engineer be employed to look into the future sanitary requirements of the Chicago water supply which recommendation however was not acted upon.

The government requirements for potable water supplies have been

gradually brought to a high standard. Will Chicago be able to meet them without finally having to resort to filtration? If not, a tremendous problem confronts the city.

With a pumpage today of an average of 265 gallons per capita or over, or 730,000,000 gallons per day, and with the population growing at the rate of 60,000 per year, the filtering of this quantity of water will be a Herculean task.

When, in addition, the sewage treatment question is taken into consideration, is it not time that much more determined efforts be made to eliminate the abnormal waste and leakage in the water supply system and bring the per capita pumpage to a reasonable quantity? These are questions that should receive the earnest attention not only of the City's officials and engineers but of every public-spirited citizen and the engineering organizations.